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DISCLOSURE OF THE INVENTION:

According to a first aspect of the invention there is provided an optical filter having a passband of less than 1nm, said filter including a plurality of cavities, one or more of said cavities including a spacer of thickness greater than 7 µm, said spacer defining two opposed surfaces each having a plurality of thin layers disposed thereon, wherein the total number of thin layers per cavity is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000.

In some embodiments the average number of thin layers per cavity is substantially less than 35 and the thickness of each of the spacers is substantially greater than 7µm.

According to a second aspect, the present invention provides an optical interleaver having a passband of less than 1nm, the interlever including a plurality of cavities, one or more of said cavities including a spacer of thickness greater than 7 µm, said spacer defining two opposed surfaces each having a plurality of thin layers disposed thereon, wherein the average number of thin layers per cavity is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of the thin layers is within the range of 1 part in 50,000 to 3 parts in 1000.

According to a third aspect, the present invention provides an optical interleaver adapted to receive a dense wavelength division multiplexed optical input signal including a plurality of channels ranging in frequency between approximately 1520nm and 1570nm, said interleaver being adapted to split said input into an output of at least two sub-sets of channels, wherein each channel has a bandwidth of less than 1nm, said interleaver having a plurality of cavities, one or more of said cavities including a spacer of thickness greater than 7 µm and wherein said spacer defines two opposed surfaces each having a plurality of thin layers disposed thereon, wherein the average number of thin layers per cavity is less

than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000.

According to a fourth aspect, the present invention provides a method of manufacturing an optical filter as described above, said method including the steps of:

producing a plurality of spacers by optically polishing a substrate, wherein at least one of said spacers has a thickness of greater than 7μm;

using thin film deposition to deposit a plurality of thin layers onto each of said spacers to form cavities, whereby the average number of thin layers per cavity is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

optically contacting said plurality of cavities to form said filter.

According to a fifth aspect, the present invention provides a method of manufacturing an optical filter as described above, said method including the steps of:

a) utilising thick film deposition to produce a spacer having a thickness of greater than 7μm;

b) utilising thin film deposition to deposit a plurality of thin layers onto said spacer to form a cavity, the average number of thin layers per cavity being less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

c) repeating combinations of steps a) and b) so as to form said filter.

According to a sixth aspect, the present invention provides a method of manufacturing an optical interleaver as described above, said method including the steps of:

producing a plurality of spacers by optically polishing a substrate, wherein at least one of said spacers has a thickness of greater than 7μm;

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using thin film deposition to deposit a plurality of thin layers onto each of said spacers to form cavities, whereby the average number of thin layers per cavity is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

optically contacting said plurality of cavities to form said interleaver.

According to another aspect, the present invention provides a method of manufacturing an optical interleaver as described above, said method including the steps of:

a) utilising thick film deposition to produce a spacer having a thickness of greater than 7μm;

b) utilising thin film deposition to deposit a plurality of thin layers onto said spacer to form a cavity, the average number of thin layers per cavity being less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

c) repeating combinations of steps a) and b) so as to form said interleaver.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram depicting a typical narrow band filter according to the prior art;

Figures 2 to 7 are graphs illustrating various performance characteristics of a typical example of the prior art filter according to figure 1, as described in more detail in the above discussion of the prior art;

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fibres to be dramatically increased, thereby helping to address the rapidly growing world wide demand for digital telecommunications, for example due to increases in internet usage.

Preferred Methods for Manufacturing Filters According to the Invention:

A first preferred method of manufacturing an optical filter 1 in accordance with the invention includes the steps of:

producing a plurality of spacers 5 by optically polishing a substrate, wherein at least one of said spacers 5 has a thickness of greater than 7μm;

using thin film deposition to deposit a plurality of thin layers 7 onto each of said spacers 5 to form cavities 4, whereby the average number of thin layers 7 per cavity 4 is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

optically contacting said plurality of cavities 4 to form said filter 1.

It will be appreciated that the spacer thicknesses tolerances required for manufacture of the preferred embodiments of the optical filter are within the capabilities of those skilled in the art of optical polishing. Similarly, the required thin layer tolerances are within the capabilities of those skilled in the art of thin film deposition.

The second preferred method of manufacturing an optical filter 1 in accordance with the invention includes the steps of:

a) utilising thick film deposition to produce a spacer 5 having a thickness of greater than 7μm;

b) utilising thin film deposition to deposit a plurality of thin layers 7 onto said spacer 5 to form a cavity 4, the average number of thin layers 7 per cavity 4 being

less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

c) repeating combinations of steps a) and b) so as to form said filter 1.

In the exemplary preferred embodiments described above the spacer is made of SiO_2, a material with a relatively low refractive index in comparison to many other

8mm, consisting of a total of 41 layers (optimised down from the starting design of 43 layers, 3 S 3 S 3 S...). There are 10 high order thick layers and 31 $\lambda/4$ layers.

Figures 28 and 29 show the spectral transmittance and reflectance respectively of the preferred embodiment. It can be seen that the preferred embodiment divides the input signal into alternate odd and even channels.

As was the case for the filter described above, the tolerances for the interleaver are relatively relaxed compared to the prior art. The maximum allowable uniformity error in the thickness of each of said thin layers is preferably equal to or less than 5nm. The maximum allowable uniformity error in the thickness of each of said spacers is equal to or less than 8nm. Figures 30 and 31 show the effects of these errors respectively.

<u>Preferred Methods for Manufacturing Interleavers According to the Invention:</u>

A first preferred method of manufacturing an optical interleaver as described above includes the steps of:

producing a plurality of spacers by optically polishing a substrate, wherein at least one of said spacers has a thickness of greater than 7µm;

using thin film deposition to deposit a plurality of thin layers onto each of said spacers to form cavities, whereby the average number of thin layers per cavity is less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

optically contacting said plurality of cavities to form said interleaver.

An alternative preferred method of manufacturing an optical filter as described above includes the steps of:

a) utilising thick film deposition to produce a spacer having a thickness of greater than 7µm;

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b) utilising thin film deposition to deposit a plurality of thin layers onto said spacer to form a cavity, the average number of thin layers per cavity being less than 35 and wherein the maximum allowable uniformity error in the thickness of each of said thin layers is within the range of 1 part in 50,000 to 3 parts in 1000; and

c) repeating combinations of steps a) and b) so as to form said interleaver.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that it may be embodied in many other forms.